Space Weather Technical Forecast

Issued on Monday, 06 February 2023 at 13:25 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Slight chance of G1/Minor Storm intervals days 1 and 2 (6th/7th). Probable increase in X-ray flare activity.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low over the past 24 hours, with X-ray activity recorded at GOES16 generally subdued near the B/C flux boundary, and no significant flares observed.
There are now nine sunspot regions on the visible disc, with two new regions developing in the northeast quadrant during the period (AR3213 (Bxo/Beta) and AR3214 (Cro/Beta)) and two regions appearing round the northeast limb (AR3215 (Cro/Beta) and AR3216 (Hsx/Alpha)). All regions remain relatively small or magnetically simple, although AR3211 Dao/Beta, in the southwest, did exhibit some small penumbra growth during the period.
Up to three prominence eruptions were observed in the period: two were visible in both EUV and Cerro Tololo H-Alpha imagery from the southeast limb. These comprised of an impulsive eruption at 05/1400TC; and secondly a slower release starting 05/2000UTC. Another prominence can be seen leaving the southwest limb shortly after 060/0000 UTC. None of these events are likely to effect Earth, and thus no Earth-directed CMEs were observed during the period.

Solar Wind / Geomagnetic Activity: Solar wind parameters, as observed by DSCOVR and ACE at L1, indicated the onset of a negative polarity coronal hole high speed stream. The solar wind speed was slow but increased to slightly elevated levels by 06/0220 UTC, with a peak of 450 km/s by the end of the period. The solar wind density was below average (< 5ppcc) initially but increased to average or slightly above average from 06/1600 UTC, with a peak of 18 ppcc at 05/2320 UTC. The IMF was moderate (8-13 nT) 05/1800-06/1000 UTC, otherwise it was weak (< 8 nT). The north-south component showed an erratic tendency, with a gradually increasing amplitude to peak between +8 and -10nT. Finally, the phi angle was mostly negative (towards the Sun) during the period, but a brief change to positive was seen 05/2245-06/0100 UTC. Geomagnetic activity was Quiet (Kp 1-2) but became Unsettled (Kp 3) from 06/0000 UTC.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) as measured at GOES16 remained at Background levels throughout.
The high energy electron flux (greater than 2MeV) measured by GOES16 was predominantly at Normal Background levels. The associated 24-hour electron fluence was well below the Active threshold on steady trend. The observed fluence at 06/0001 UTC was1.36e6 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Low solar activity is likely to continue , however there are signs that the arriving eastern limb contains more potent active regions (from CME evidence, prominences and STEREO A EUVI 195 imagery), with a probable increase in activity therefore considered through the coming UTC working week, and thus an increasing Chance of M-class flares.

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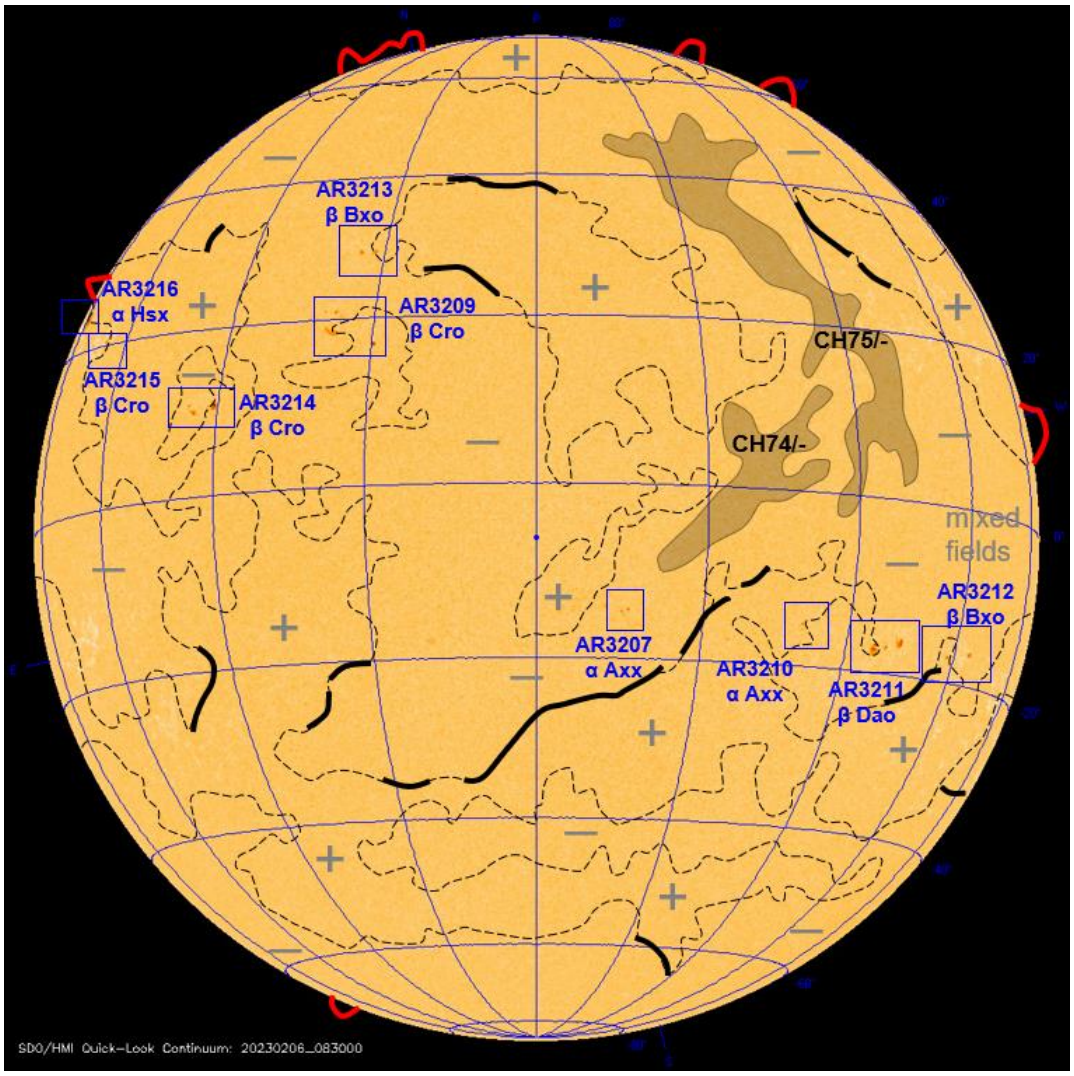
Solar Wind / Geomagnetic Activity: No definitively Earth-directed CMEs feature in the forecast at present, although given the sheer number of peripheral CMEs over the UTC weekend, confidence in this assertion is relatively low, especially from day 3 (8th). Non-impactful glancing transient activity is considered a possibility from midweek.
The current enhanced solar wind environment is expected to continue until day 3 (8th), when effects from CH74/- and CH75/- are expected to wane. Unsettled to Active geomagnetic conditions, with a slight chance of G1 Minor Storm intervals, should reduce to predominantly Quiet levels from midweek UTC.

Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux observed by GOES16 is expected to remain at Background levels throughout given the dearth of current sunspot groups.
Background electron flux is likely to increase to Moderate or perhaps High levels from midweek (UTC), due to the fast wind environment, although the corresponding electron fluence is unlikely to exceed the Active (1e8 integrated pfu) threshold in the forecast timeframe.

Figure 1. Solar Analysis Valid 06/0800 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

There are no definitively Earth-directed CMEs currently in the forecast. This being said, observed minor peripheral CMEs comfortably reached double figures over the past UTC weekend, and confidence in this assertion is therefore lower than typical. It is probable that non-impactful minor glancing CME incidence may occur later this working week, and attribution to any one event is likely to be very difficult. This is reflected in some of the MOSWOC Enlil ensemble members showing minor deviations from the unperturbed deterministic run on or after the second half of Tuesday 07 February, i.e. day two. This is felt to lie on the early end of any possible influence given Enlil's erroneous assumption that Earth has been transiting a 600-650km/s fast wind over the UTC weekend, when in fact a slow regime near 300-350km/s has instead prevailed. Any glancing CME would therefore most likely be delayed until on or after midweek UTC.

With the above uncertainties mainly affecting the second half of the coming UTC working week, fast winds from CH74/- and CH75/- will characterise the start, with Earth now experiencing a negative high speed stream. Solar winds should remain slightly elevated or elevated until day 3 (8th) when they are forecast to gradually decline as coronal hole effects wane.

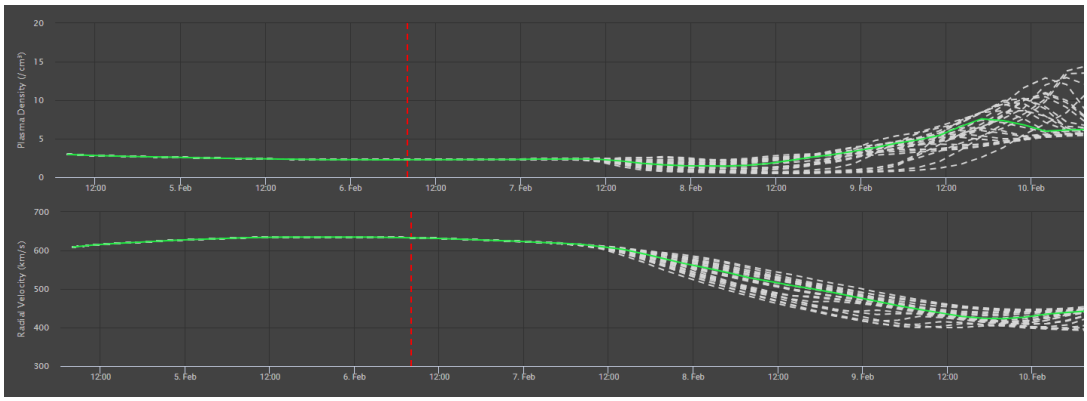
All considered, Unsettled to Active geomagnetic conditions, with a slight chance of G1 Minor Storm intervals should reduce to predominantly Quiet levels from midweek UTC. However, there is a degree of uncertainty regarding this given passing transients through the second half of the UTC week.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	20	20	5	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Nil

Figure 2: Enlil ensemble.



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Radio Blackouts - X-Ray Flares:

The current solar disc consists of 9 sunspot groups, however these are all relatively small and simple, resulting in Low solar activity. Activity is likely to remain through the forecast period, although there is the potential for the arrival of numerous Carrington locations for spot groups over the eastern limb in the first half of the coming UTC working week. In numerical order EX3188; 3190; 3191; 3192; 3194 and 3195 are all due over the coming days. Therefore there is an increasing chance through the period of moderate solar activity and isolated M-class flares.

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**R1-R2 M Class**	No	15	20	30	30
Very Active	**R3 to R5 X Class**	No	1	1	1	1

Solar Radiation Storms - (High Energy Protons):

High energy (greater than 10MeV) proton flux as observed by GOES16 is at Background levels, and is currently expected to remain as such throughout the period given the absence of significant sunspot groups.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	1	1	1	1
Very Active	**≥ S3 ***	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

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High Energy Electrons Event (≥ 2MeV):

High energy electron flux (greater than 2MeV) as observed by GOES16 is currently at Normal Background levels, and is expected to remain so in the near-term. However, an eventual increase to Moderate and perhaps High levels is likely from midweek UTC in a response to the current coronal hole fast wind environment. STEREO A is currently giving very noisy traces for solar wind speed arising from CH74/- and CH75/- of between 500 and 750km/s, however something nearer the bottom end of this range is considered most likely, which would perhaps give an eventual Chance of fluence exceeding Active.

MOSWOC REFM is rendered less useful for this forecast period as the solar wind enhancement is both non-persistent and potentially polluted by minor transient activity later this working week.

GEO Electron Environment Probability (Exceedance)	Level ($cm^{-2}\,sr^{-1}\,day^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^{8}$**	No	1	10	20	40
Very Active	**≥ 2 MeV ≥ $1x10^{9}$**	No	1	1	1	1

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